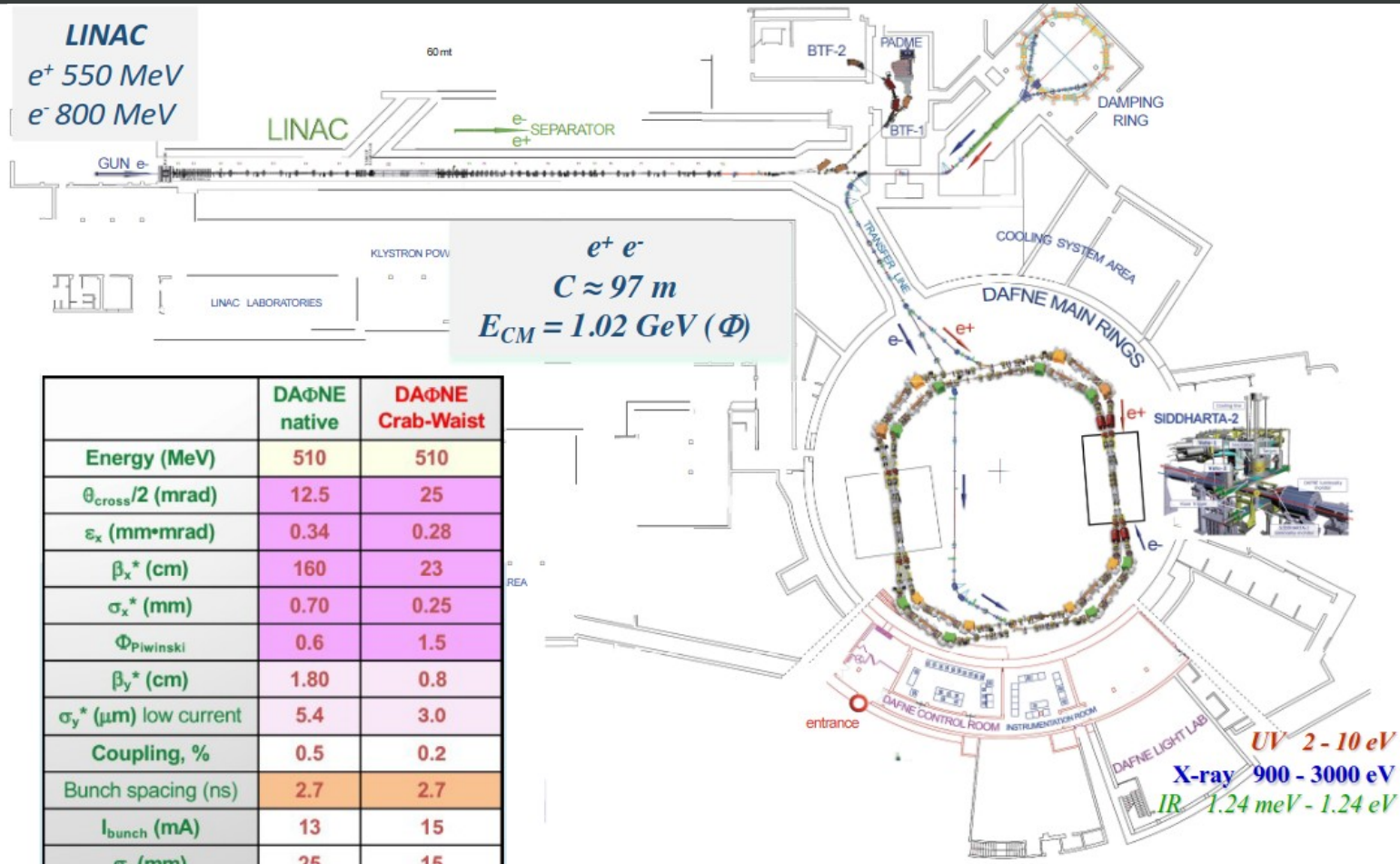
DAFNE Activity report

Antonio De Santis
On behalf of the DAFNE Team

DAFNE Team

C. Milardi (*Scientic Head*), S. Bilanishvili, S. Bini, M. Boscolo,
B. Buonomo, S. Cantarella, A. Ciarma, A. De Santis, E. Di Pasquale,
C. Di Giulio, G. Di Pirro, O. Etisken, L. Foggetta,
G. Franzini, A. Gallo, R. Gargana, S. Incremona, A. Liedl,
A. Michelotti, L. Piersanti, D. Quartullo, R. Ricci, U. Rotundo,
S. Spampinati, A. Stecchi, A. Stella, A. Vannozzi, M. Zobov.
S. Ozdemir, (master student from Izmir University, Turkiye).

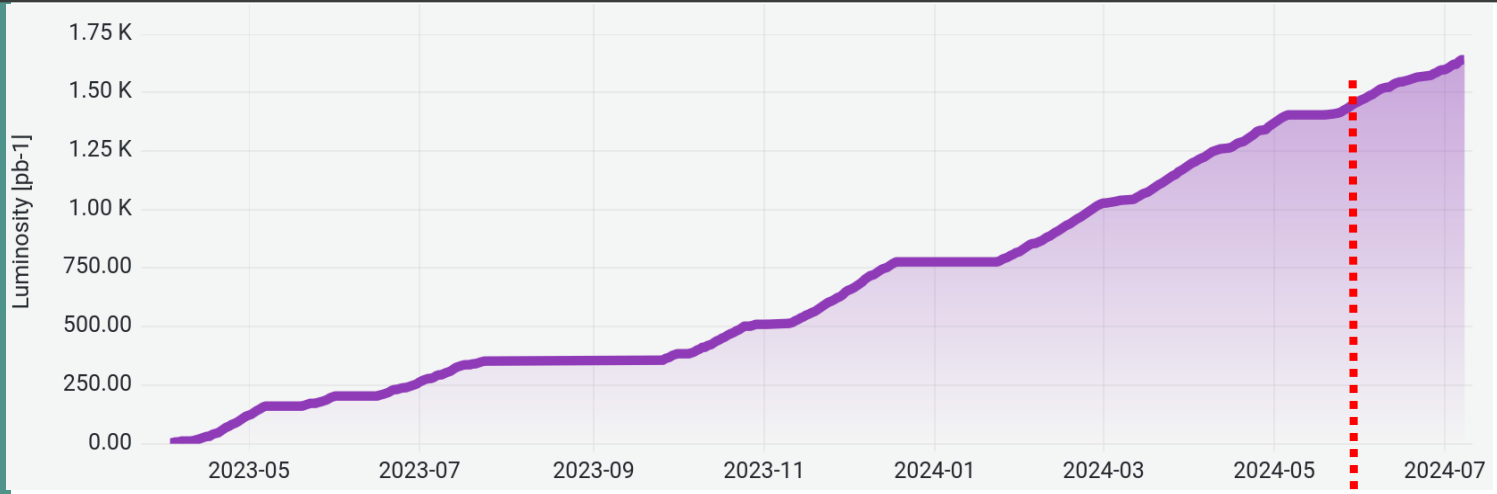
DAFNE Complex



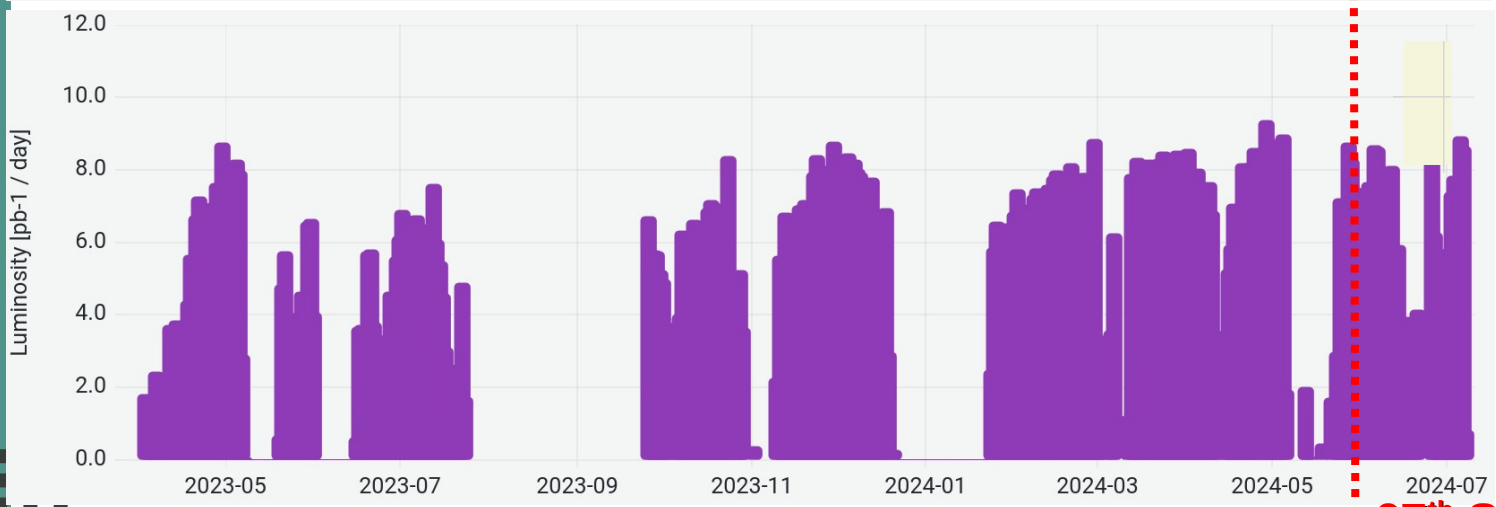
	DAΦNE native	DAΦNE Crab-Waist
Energy (MeV)	510	510
$\theta_{cross}/2$ (mrad)	12.5	25
ε_x (mm•mrad)	0.34	0.28
β_x^* (cm)	160	23
σ_x^* (mm)	0.70	0.25
$\Phi_{Piwinski}$	0.6	1.5
β_y^* (cm)	1.80	0.8
σ_y^* (μm) low current	5.4	3.0
Coupling, %	0.5	0.2
Bunch spacing (ns)	2.7	2.7
I_{bunch} (mA)	13	15
σ_z (mm)	25	15
h	120	120

SIDDHARTA-2 Run History

SIDDHARTA-2 Run: Luminosity delivery

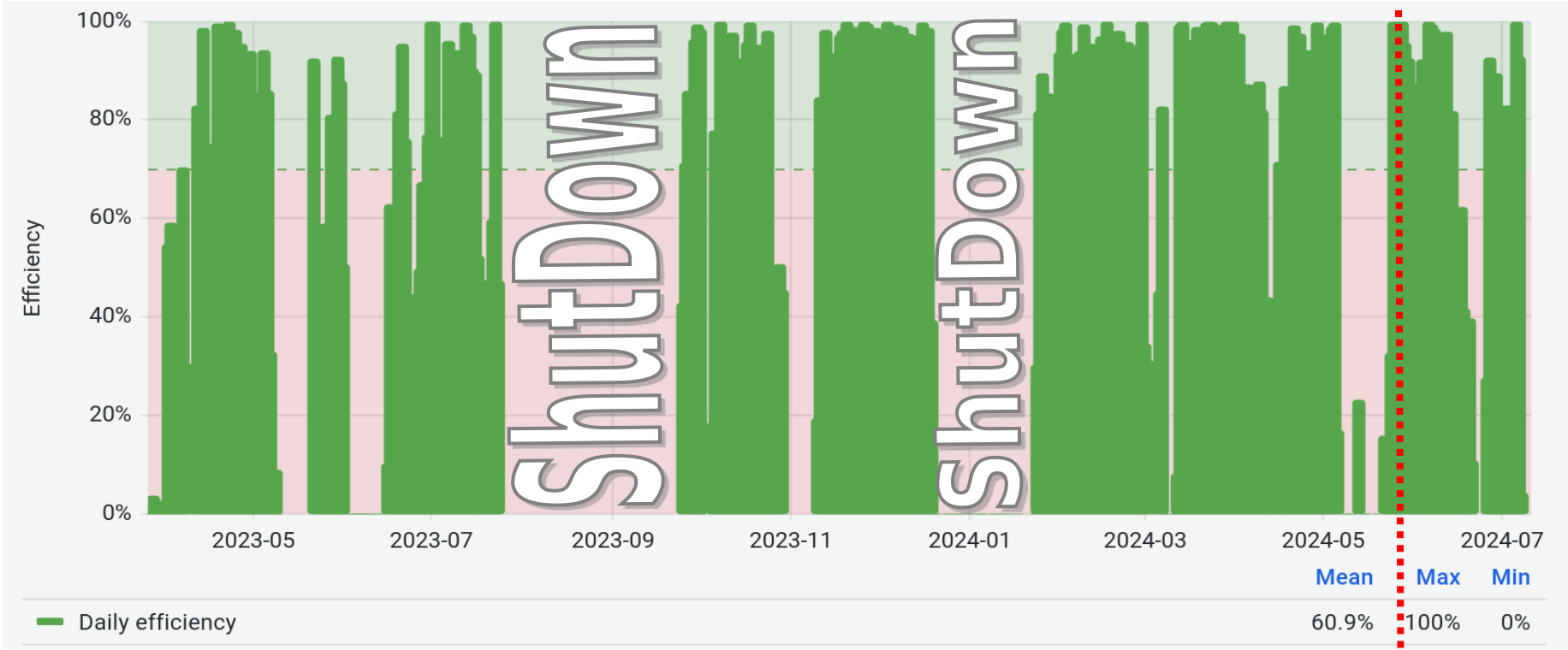


Total: 1.64 fb-1



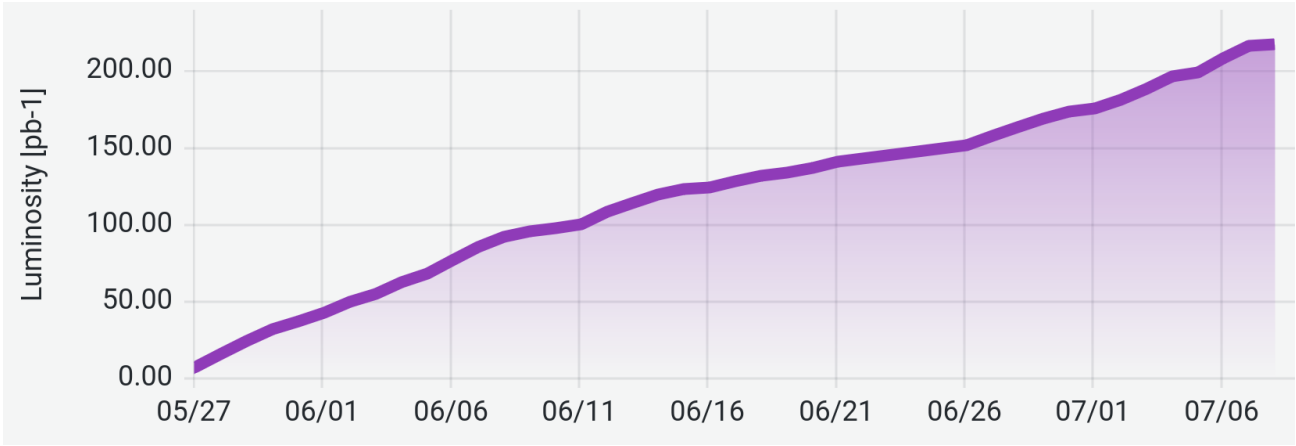
Max: 9.4 pb-1/day

SIDDHARTA-2 Run: Delivery efficiency



Recent Activity (since last SciCom)

Luminosity delivery: Low density Run

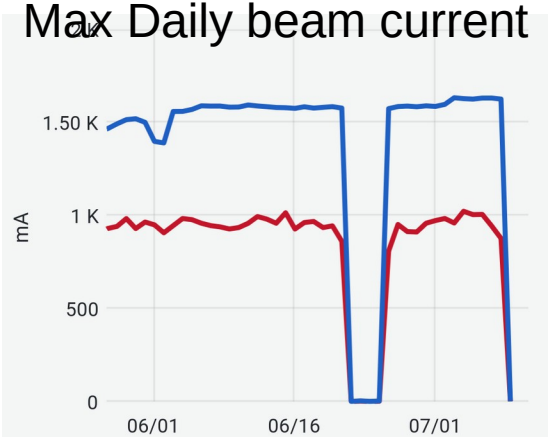


Duration: 37 day

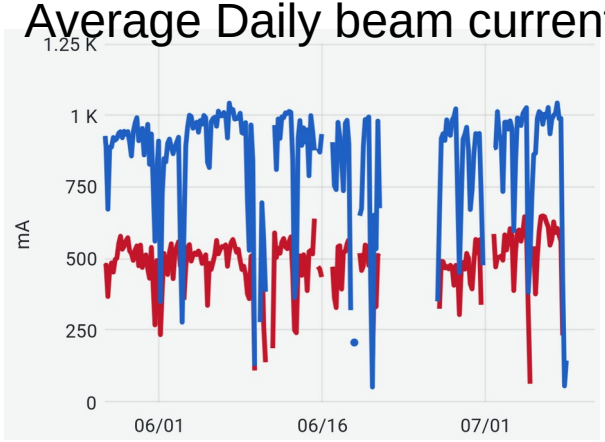
Total: 220 pb^{-1}

Average daily: 6 pb^{-1}

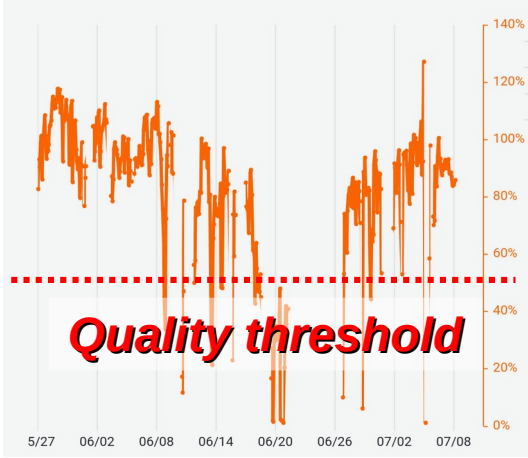
Max Daily beam current



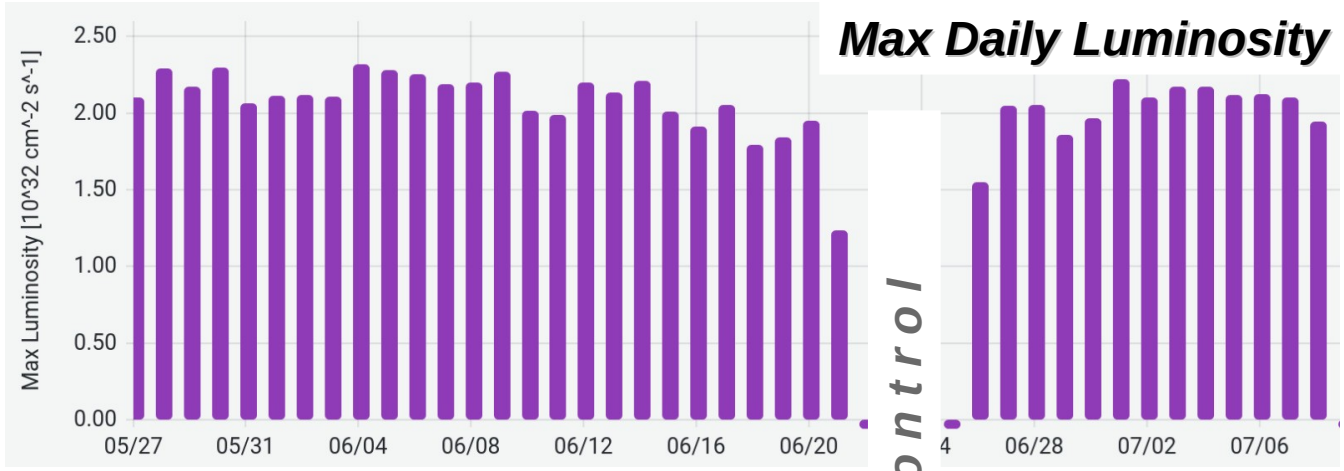
Average Daily beam current

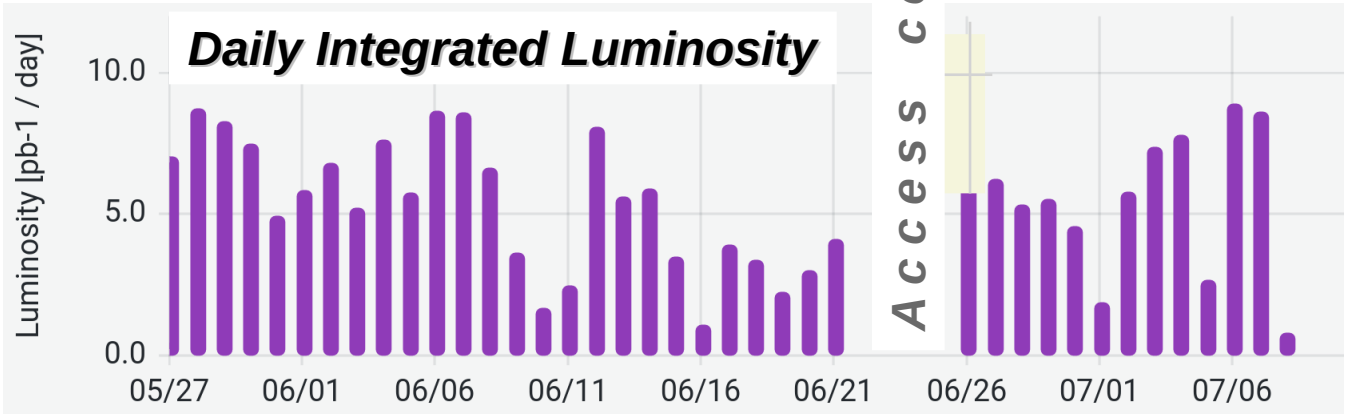


Kaon/SDD rate



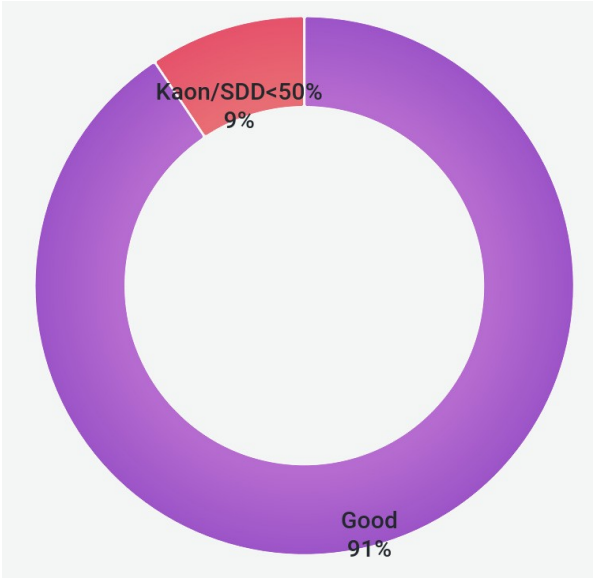
Delivery Data quality



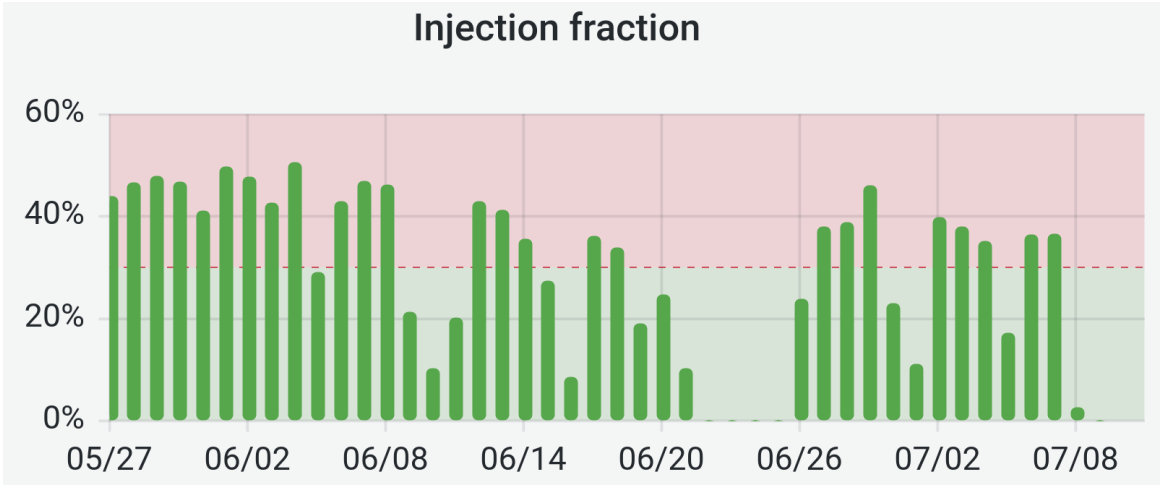


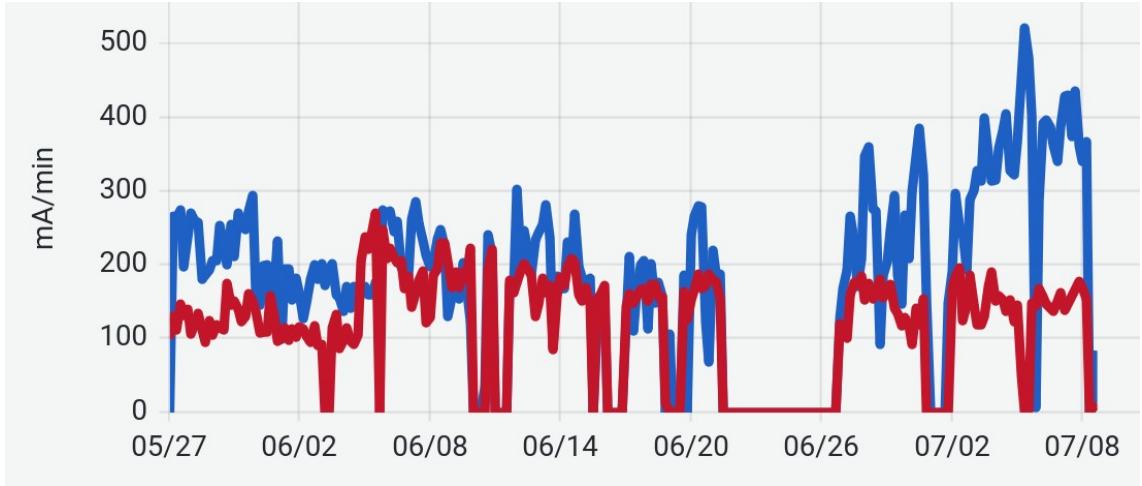
Access control

Kaon/SDD Quality factor



Injection rate/efficiency

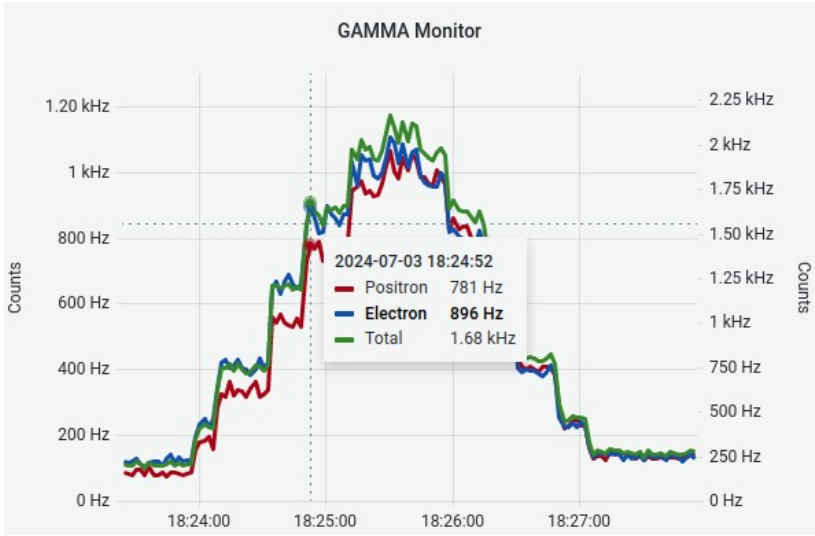




Injection has been kept under control despite the high outside temperature

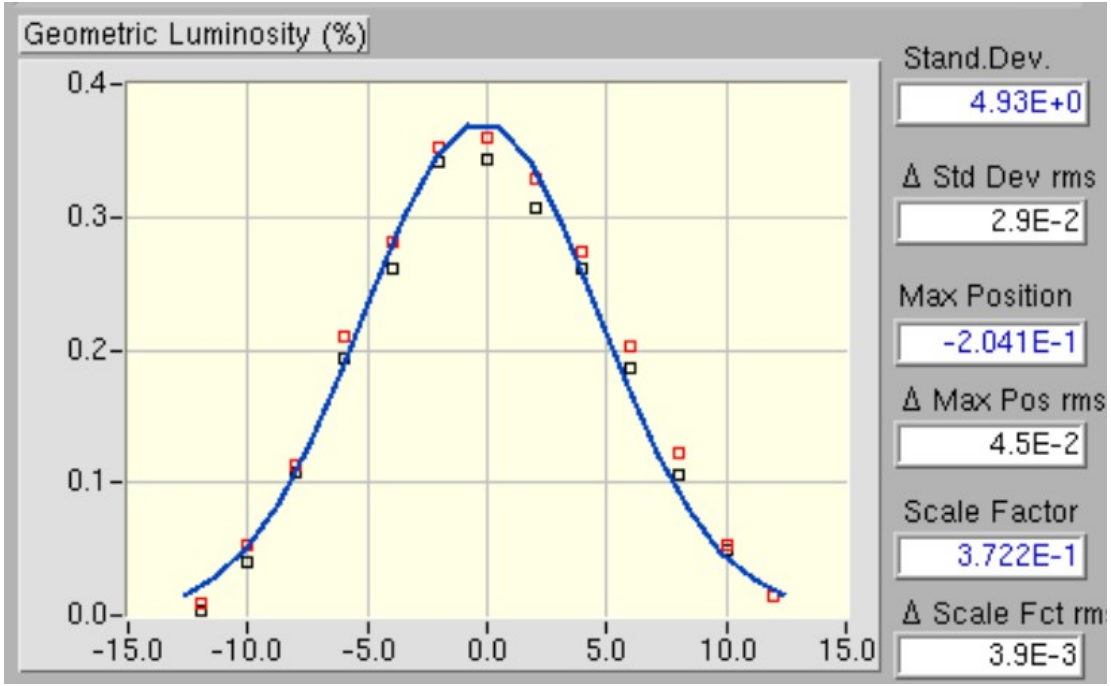
The last period has been characterized by a quite high efficiency in the operations

Verical beam-beam scan



I_{beam}: 80 mA
Σ_{SLM} = 150/135 μm
Σ(extrapolated) = 4.2 μm
Σ(collision) = 5.0 μm (convoluted)
σ^{+-}(single) = 3.5 μm

Beam-Beam scan with calibrated bump



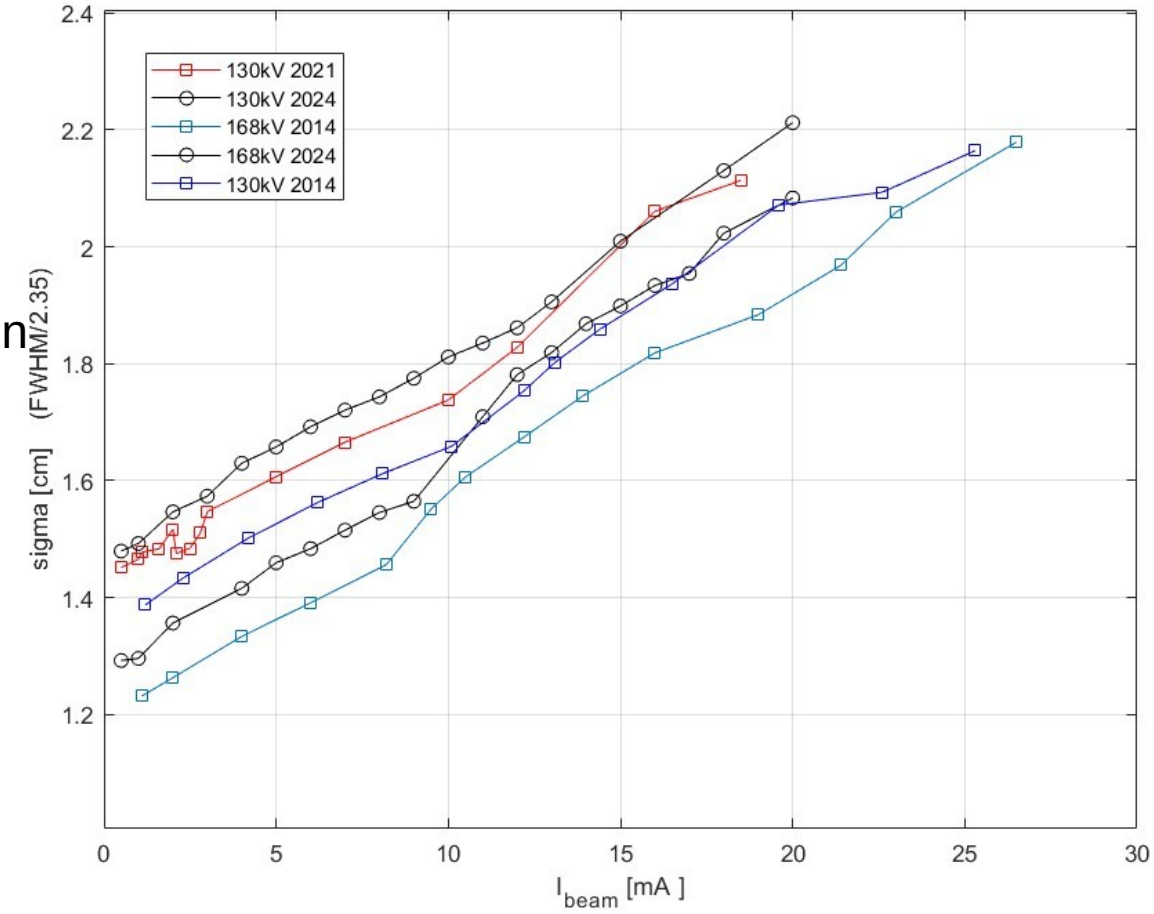
Ring characterization: bunch length vs Ibeam and VRF

The bunch length increase linearly with the bunch current at low RF voltage (130 kV)

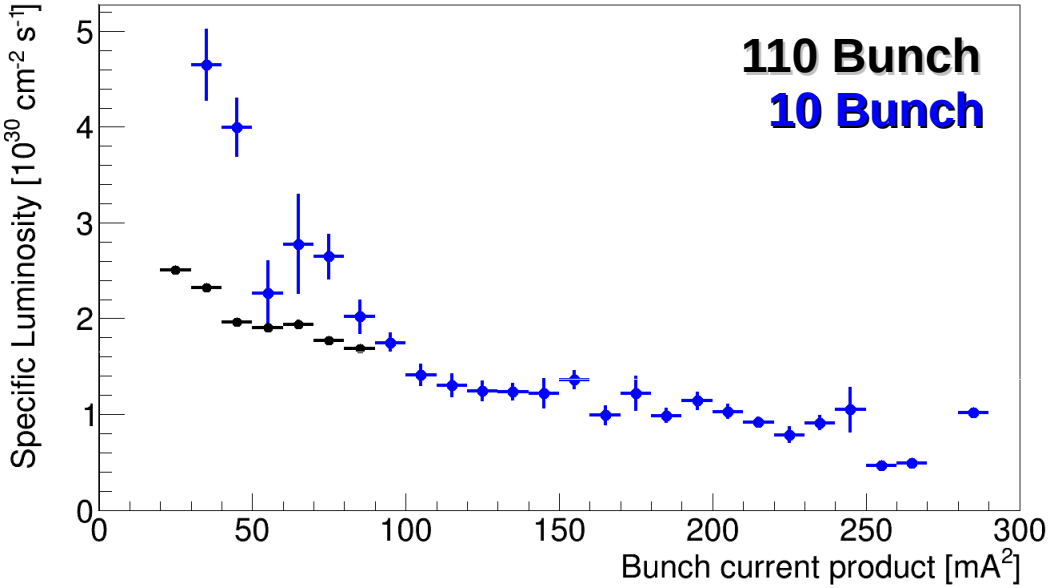
For higher values (170 kV) microwave threshold lowers and non linear effects is observed

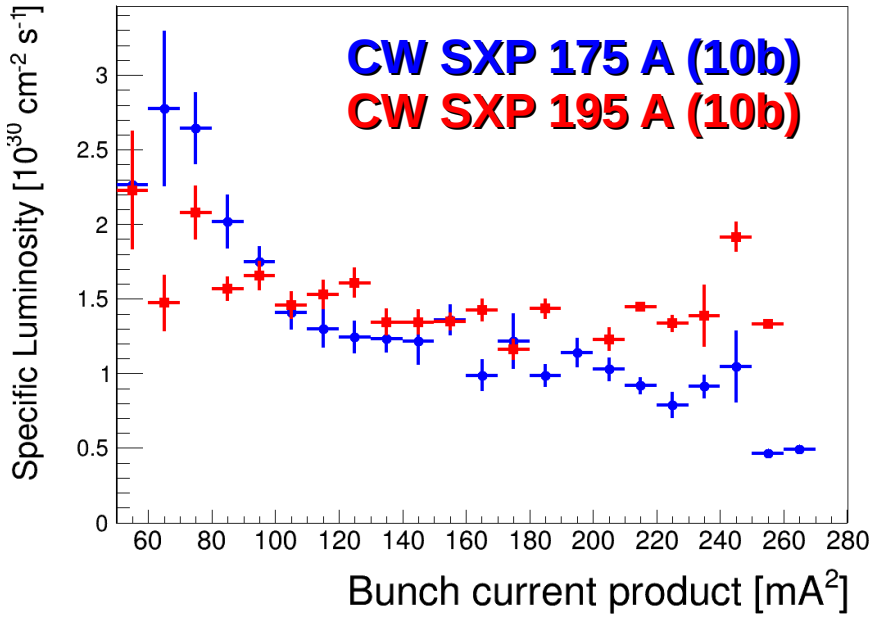
Considering the different machine setup (optics, scrapers) the results appears compatible along the time.

Further investigation in specific positions (direct inspection of bellows) where temperature rises have been observed could be useful.



Collision characterization: 10 bunches luminosity

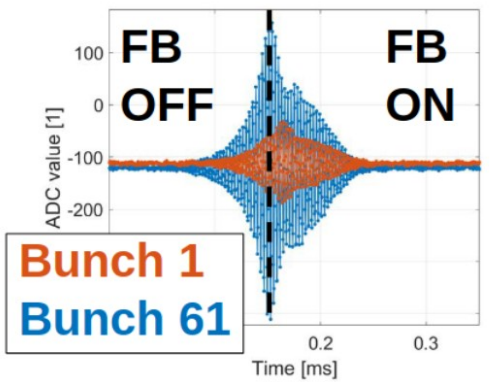


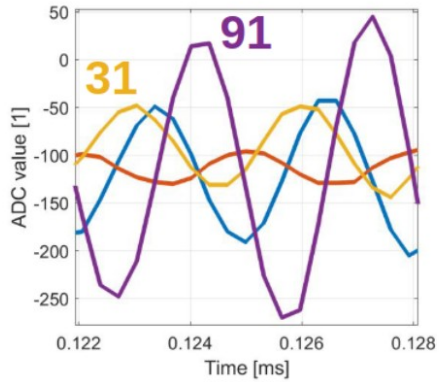


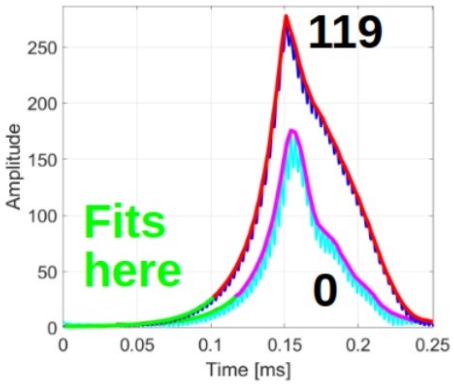
In the normal operations the single bunch current is strongly limited
Neglecting collective effects (10 bunches collisions) the specific luminosity is almost twice the one normally obtained with 110 bunches

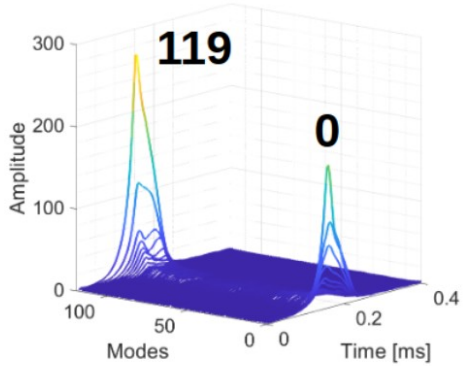
With higher value of the Crab-Waist sextupoles it is possible to reach even higher specific luminosity at high bunch current.

Positron beam dynamics: Grow-Damp measurement



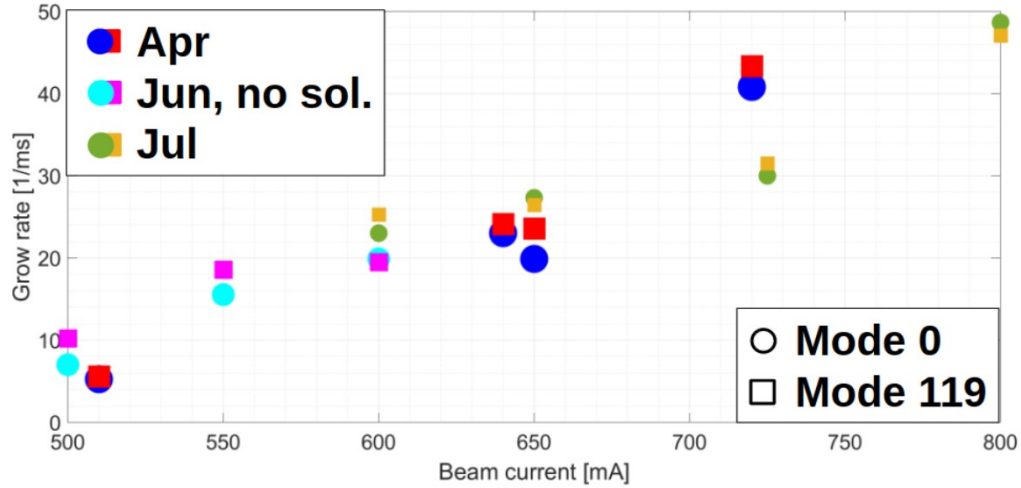






Grow-damp measurements with modal analysis to characterize the horizontal multi-bunch instabilities.

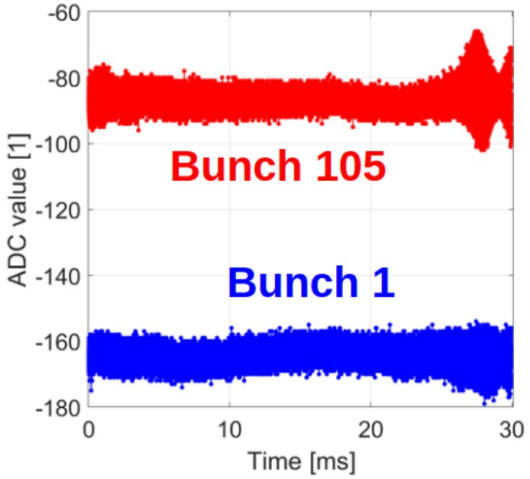
For 105 bunches at 800 mA, the dominant mode is 119, followed by mode 0.

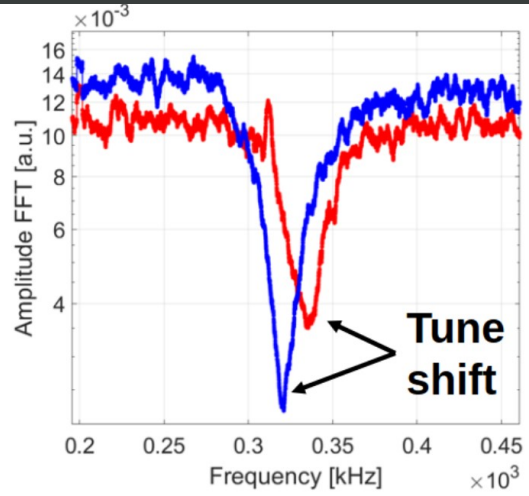


- Exponential fits of the modes envelopes.
- Grow rates increase with higher beam currents, as expected.

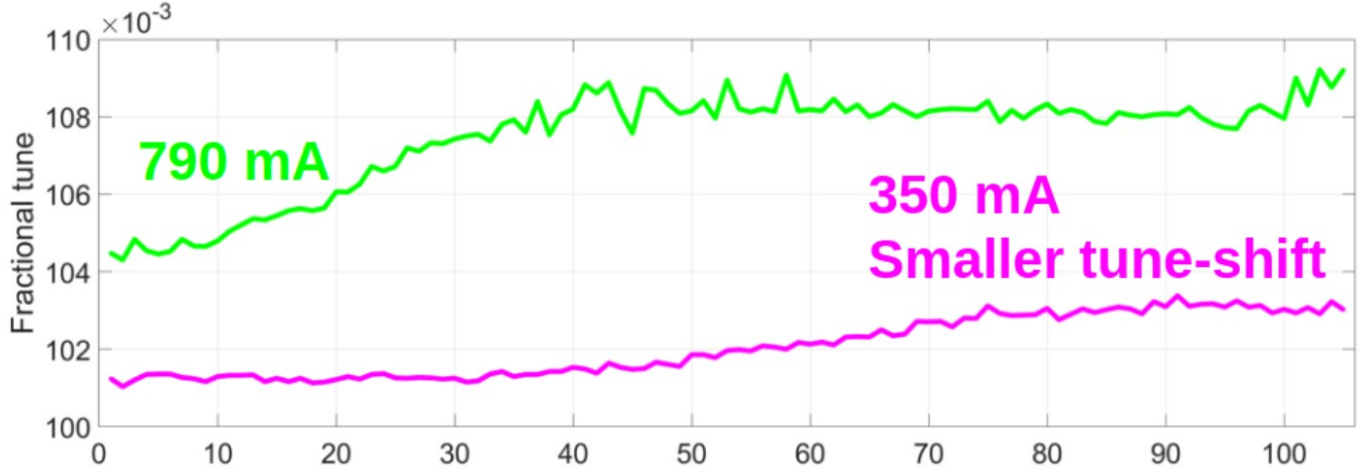
Presented at IBIC2024 - THP65

Positron beam dynamics: MRp tune shift measurement





Presented at IBIC2024 - THP65

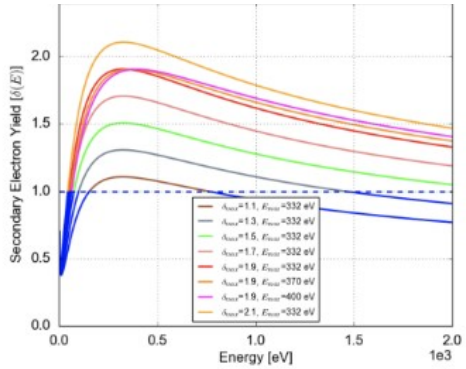


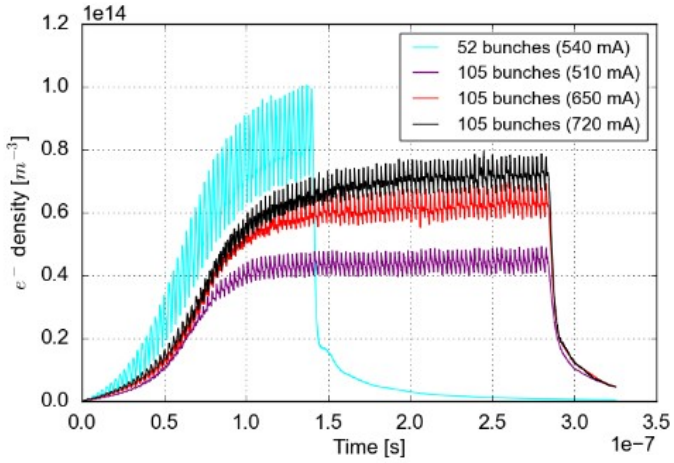
Ring characterization: eCloud simulation

E-cloud build-up simulation by using PyECLOUD code.

E-cloud formation depends on many parameters: external magnetic fields, geometry, chamber surface, bunch spacing, bunch intensity, bunch length, bunch number, beam sizes, and Secondary Electron Yield (SEY).

SEY for Al surface: δ_{max} =1.9 and E_{max} = 332 eV



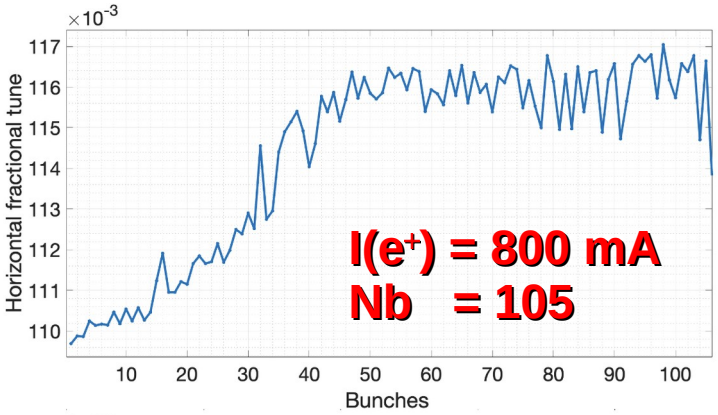


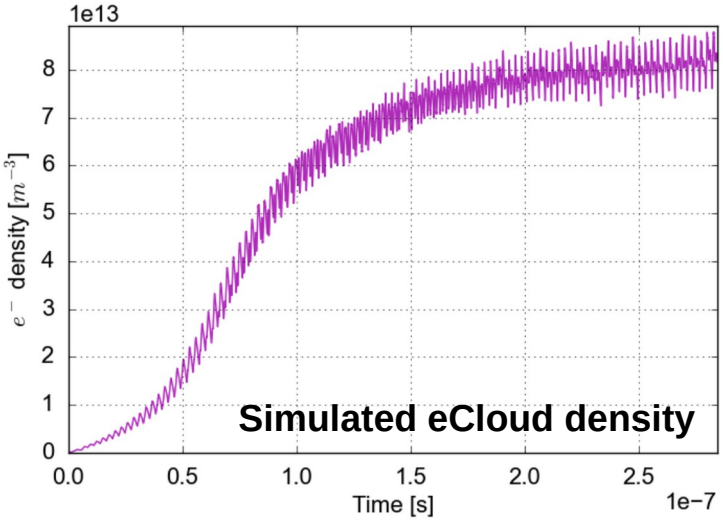
	Meas	Simulated
Bunch no	**Growth rate**	**e^- density**
105 bunches [720 mA]	44 ms^{-1}	0.8×10^{14} m^{-3}
105 bunches [650 mA]	22 ms^{-1}	0.7×10^{14} m^{-3}
105 bunches [510 mA]	6 ms^{-1}	0.5×10^{14} m^{-3}
52 bunches [540 mA]	18 ms^{-1}	1.0×10^{14} m^{-3}

Beam current	**Measured tune shift**	**e^- density**
800 mA	7.0×10^{-3}	8.8×10^{13} m^{-3}
750 mA	6.3×10^{-3}	8.0×10^{13} m^{-3}
600 mA	4.8×10^{-3}	6.0×10^{13} m^{-3}
400 mA	3.3×10^{-3}	3.5×10^{13} m^{-3}

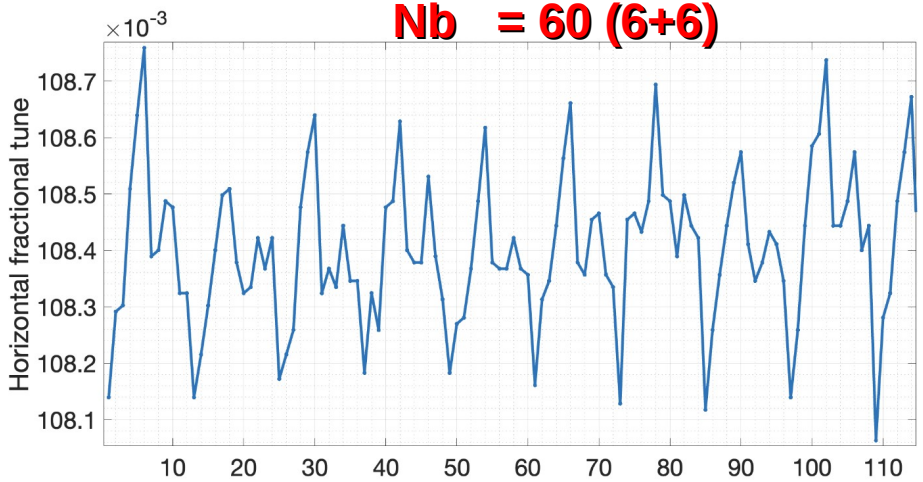
Presented at IPAC2024-WEPR08

Ring characterization: eCloud simulation

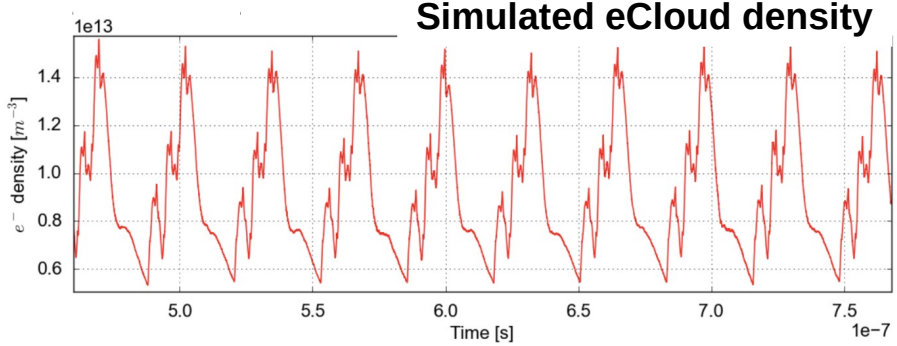




I(e+) = 290 mA
Nb = 60 (6+6)

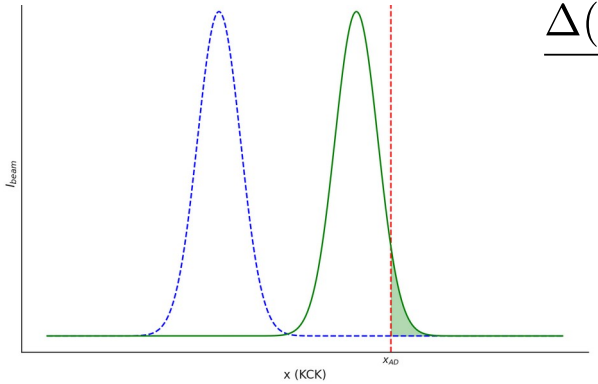


Simulated eCloud density



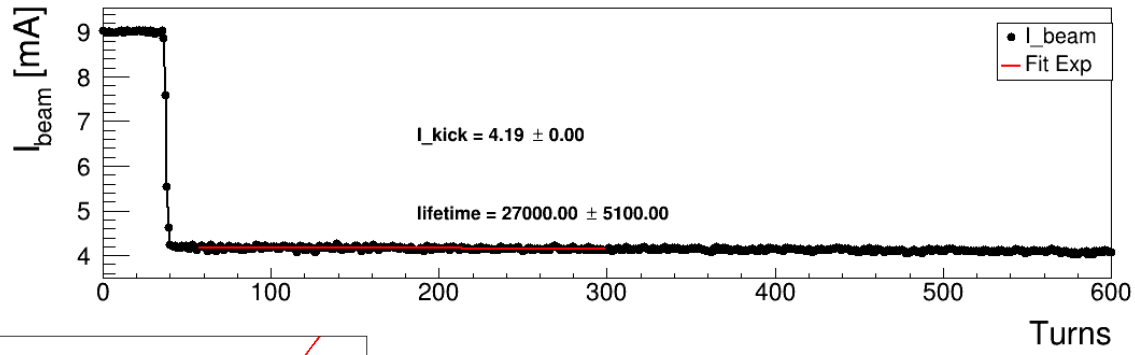
Presented at IPAC2024-WEPR08

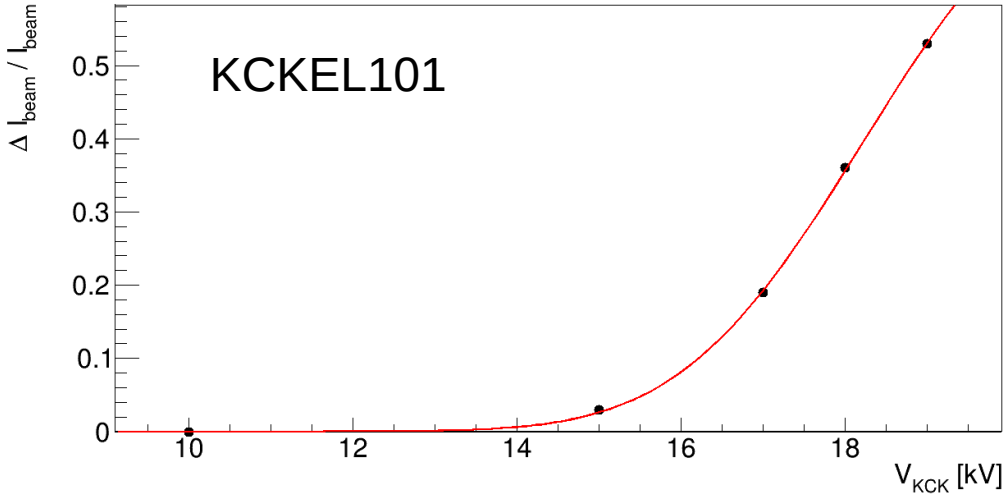
Dynamic Aperture measurement



$$\frac{\Delta(I_0 - I_{KCK})}{I_0} \propto \int_{x_{AD}}^{\infty} \mathcal{G}_{beam}(x;\sigma)dx$$

BPBES204





Measurement with:

- SCRAPER OFF
- Crab-Waist SXP OFF

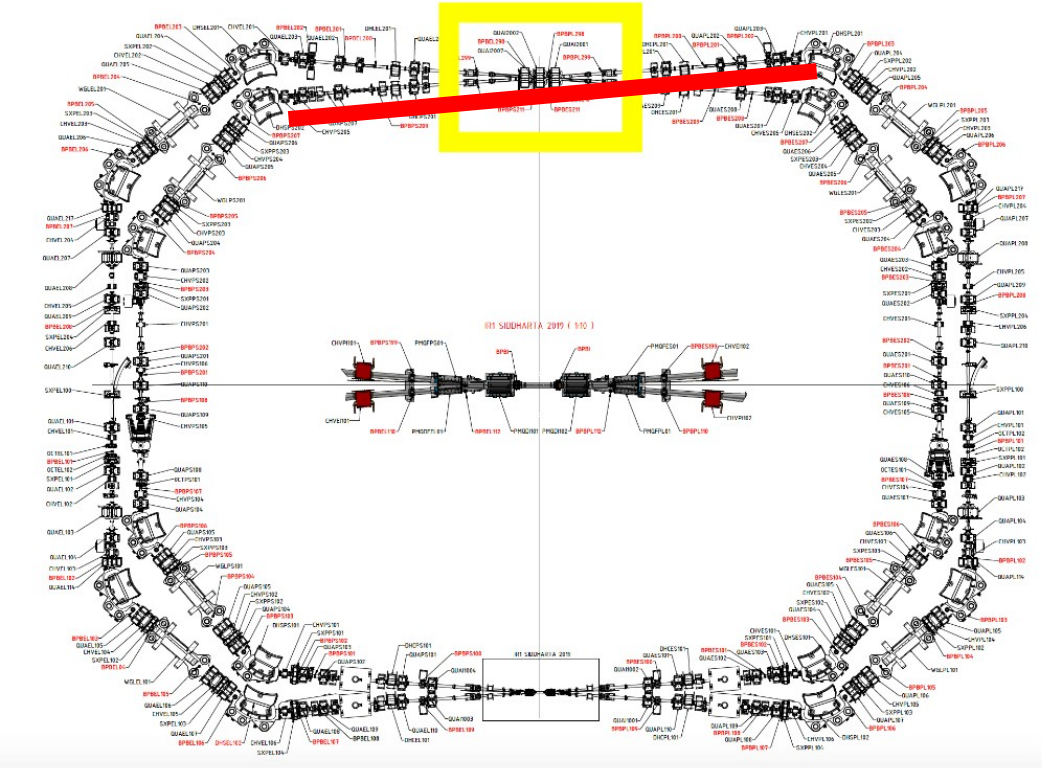
Future plan

Possible LNF/CERN collaborations

Test of the **novel FCC-ee vacuum chamber** with winglets and photon stops at the DAFNE positron ring.
Possible placement in the RCR region just after the arc in the "FINUDA" straight.
Roberto Kersevan (CERN Vacuum) thinks this could easily be implemented and would be extremely useful.

The vacuum group has prototype chambers to be directly installed.

We should foresee some e-cloud diagnostics on that chamber.



Possible LNF/CERN collaborations

$$\sigma_E(beam) = E_b\delta$$

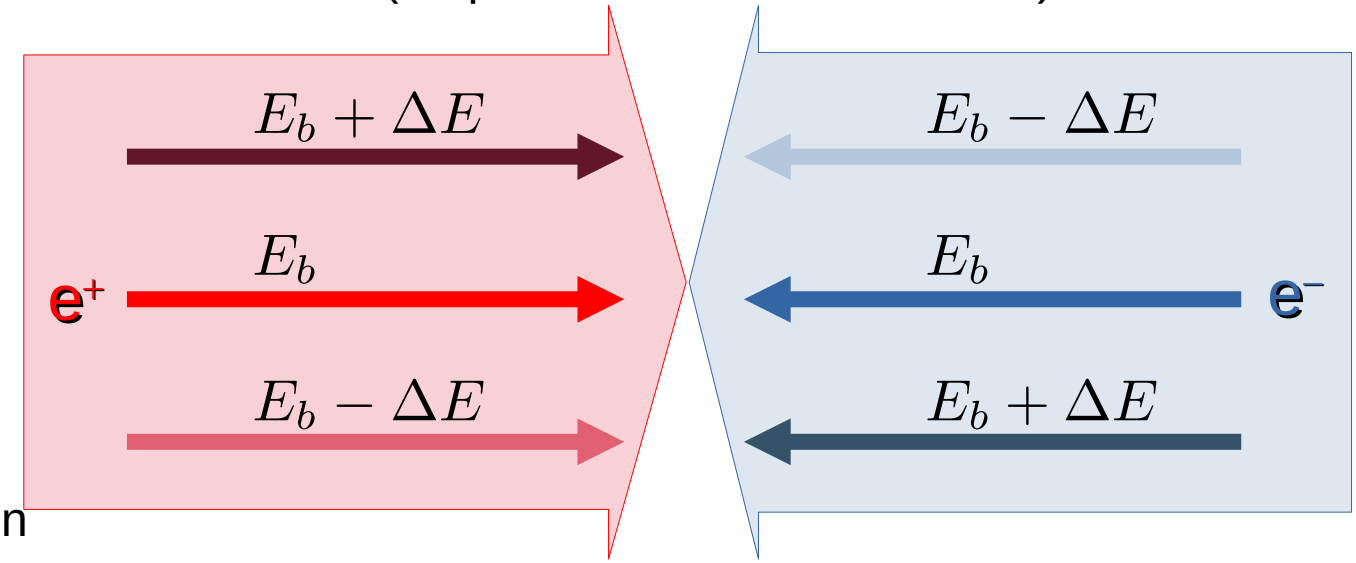
Usually:

$$w = 2E_b$$

$$\sigma_w = \sqrt{2}\delta E_b$$

Proposed by
A. Renieri 1975 (ADONE)

Monochromatization scheme
(Dispersion at Interaction Point)



Effect on energy resolution

$$w = 2E_b$$

$$\sigma_w = \frac{\sqrt{2}\delta E_b}{\lambda}$$

$$\lambda = \sqrt{1 + \delta^2\left(\frac{D_x^{*2}}{\sigma_{x\beta}^{*2}} + \frac{D_y^{*2}}{\sigma_{y\beta}^{*2}}\right)}$$

Possible LNF/CERN collaborations

At DAFNE possible test of monochromatization with <u>vertical dispersion</u>

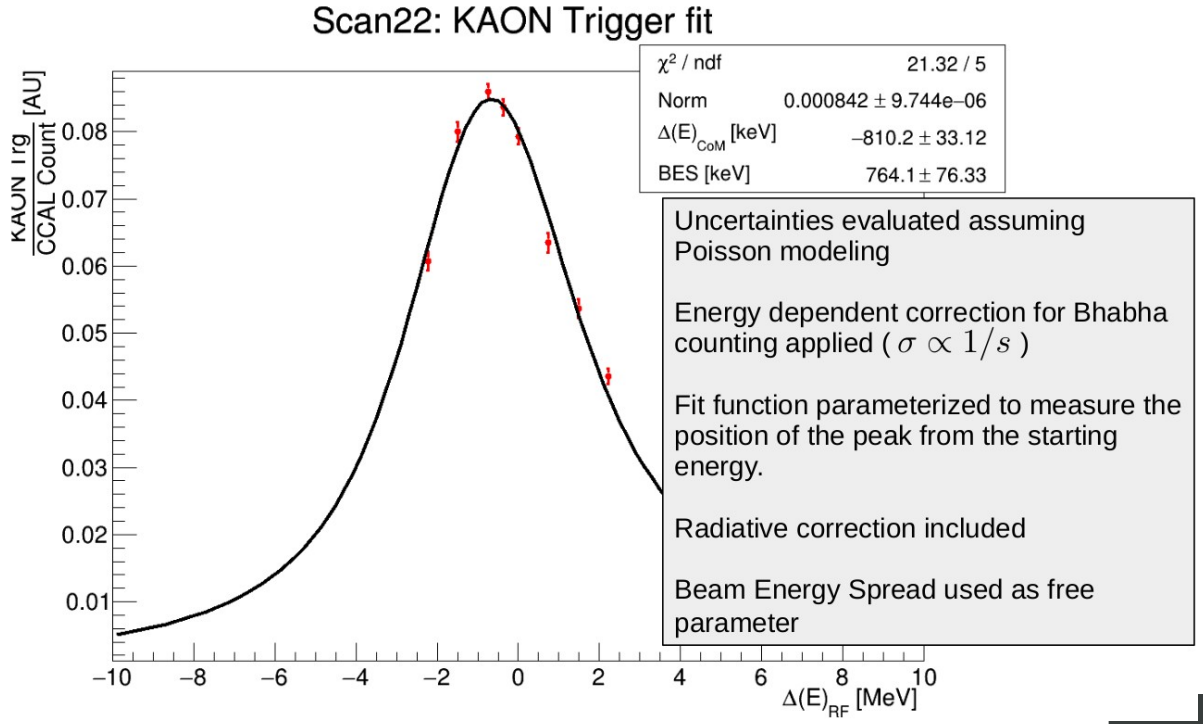
Simultaneous measurement of Kaon Rate and Bhabha scattering events rate at different energy.

Observable:

Beam Energy Spread

Similar measurement performed with KLOE and SIDDHARTA for the f-meson lineshape to verify the working point of the collider.

HIGH IMPACT ACTIVITY
NEVER TESTED



Possible LNF/CERN collaborations

Longitudinal top-up injection, if we can leak dispersion to the injection point – proposal from K. Oide – this corresponds to the FCC-ee baseline

HIGH IMPACT ACTIVITY NEVER TESTED

Tests and qualification of prototype FCC-ee beam diagnostics, e.g. BPM and related acquisition system (low-cost single bunch/turn DAQ)

Feedback studies FCCee oriented: intra-turn damping

Conclusion

DAFNE successfully completed the data delivery also exceeding the experiment request

Several important and interesting measurement have been performed and will be published

Future plans with **CERN partnership** is under discussion

Acknowledgments

Many thanks to the **Staff of the Accelerator and Technical Divisions**. Their commitment allowed to achieve the present DAFNE performances.

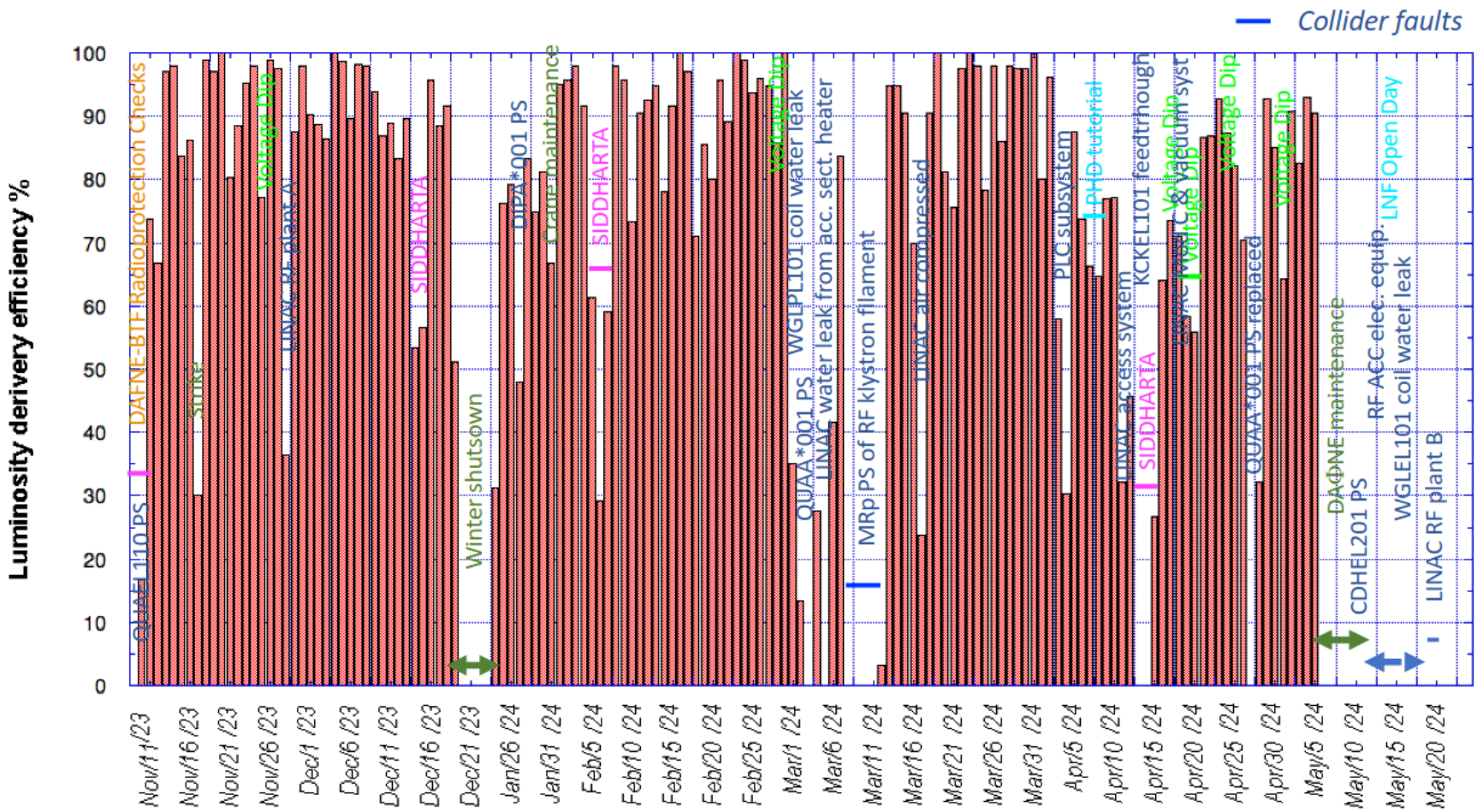
Special thanks to the **Operators** for taking care of the DAFNE infrastructure 24h a day, and for their continuous efforts in optimizing **collisions, BTF runs, synchrotron radiation** beams for the DAFNE-Luce laboratory.

Warm acknowledgment to the **SIDDHARTA-2 Team** for their fruitful cooperation.

Spare Slides

Luminosity achievements

Uptime (67th SciCom)



Longitudinal injection

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